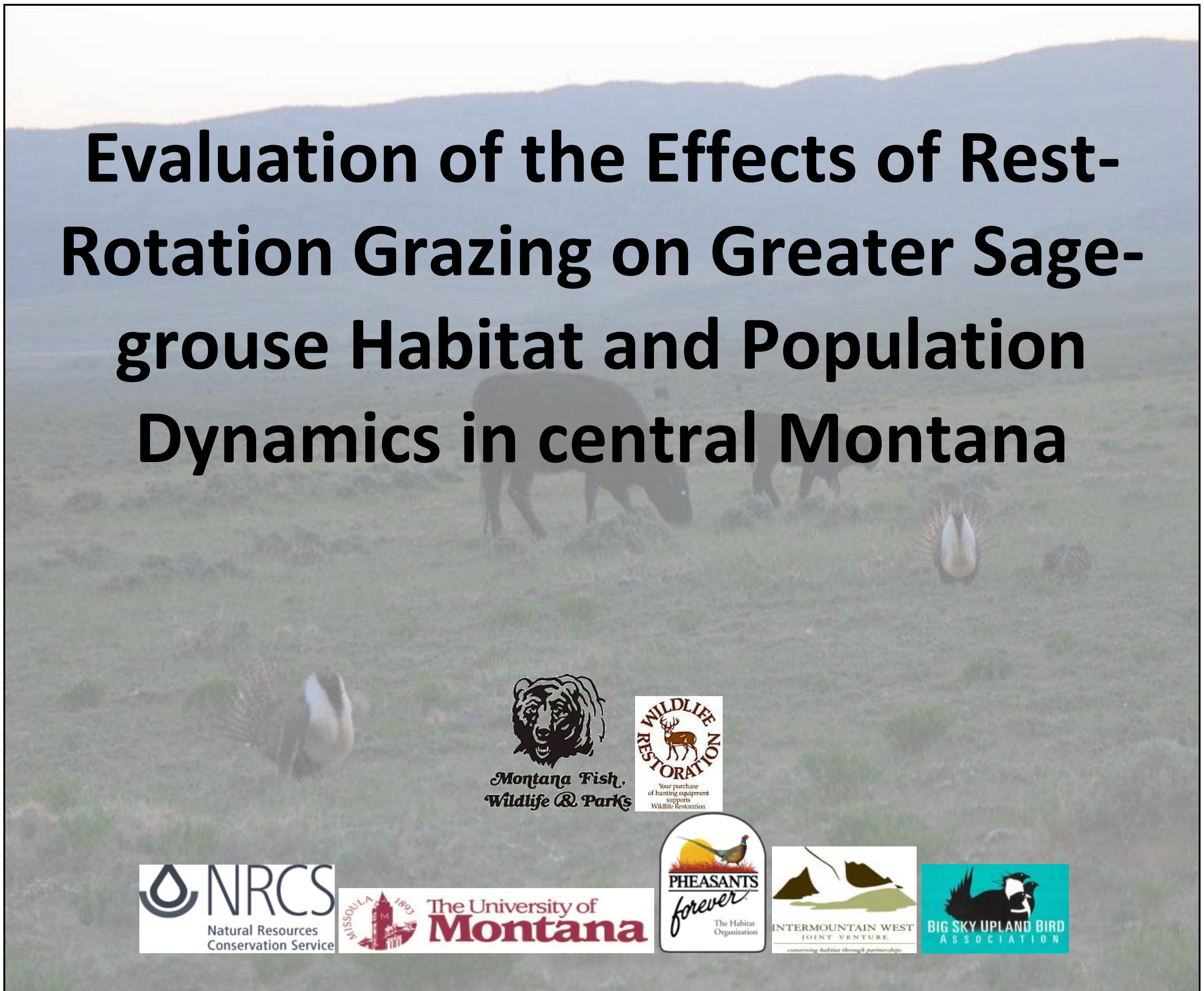
Evaluation of the Effects of Rest-Rotation Grazing on Greater Sage-grouse Habitat and Population Dynamics in central Montana



InterMountain West Joint Venture, Sage grouse Initiative Strategic Watershed Action Team Research Project

Grantee:
Montana Fish, Wildlife, and Parks

Cooperative Agreement No. 60181BJ653

April 2015 Performance Report

Period Covered: November 1, 2014 to April 30, 2015

Project End Date: June 30, 2016

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BACKGROUND

The goal of this study is to evaluate and demonstrate the effects of sage-grouse friendly livestock grazing strategies, created by the Natural Resources Conservation Service (NRCS), on the population dynamics of greater sage-grouse (*Centrocercus urophasianus*; hereafter sage-grouse) as well as sage-grouse habitat. Taylor et al. (2012) showed that hen survival, nest success, and chick survival are the 3 most important drivers of population growth in sage-grouse populations. Therefore we evaluate how best to use grazing as a management tool for sage-grouse habitat by monitoring these 3 population vital rates as well as the habitat use of sage-grouse hens and broods in response to grazing treatments. To evaluate NRCS sage-grouse friendly grazing strategies, we compare the vital rates and habitat use of sage-grouse using Sage-Grouse Initiative (SGI) contracted lands (hereafter SGI area) with that of hens in areas where there are no SGI grazing systems (hereafter non-SGI areas). In addition to the broad-scale SGI, non-SGI comparison, we categorize all pastures used by sage-grouse into 1 of 4 grazing treatments. These treatments have been defined with respect to sage-grouse ecology rather than the grazing system to enable us to extrapolate the results to grazing systems other than SGI systems. The treatments will also provide additional insights into SGI grazing systems and if/how the systems can be improved:

1. Grazed during the nesting season (April 1st – July 20th),
2. Grazed during brood-rearing (July 21st – September 15th),
3. Grazed during fall/winter after broods break-up until the start of the next breeding/nesting season (September 15th – Apr 1st), or
4. Pasture is rested the entire year (Apr 1st – Apr 1st the following year).

We communicate with non-SGI landowners to obtain grazing information on non-SGI pastures, which enables us to categorize these pastures, in addition to the SGI pastures, into the above treatments.

We have completed 4 years (corresponding with 4 years since the initiation of SGI) of this 10 year study. Annual research tasks include capturing and marking adult females (hens) with radio transmitters, finding and monitoring nests, capturing and marking sage-grouse chicks with radio transmitters, and measuring key vegetation characteristics in sage-grouse habitat and in areas with varying grazing treatments and strategies. Radio telemetry is the main technique we use to collect data on hen survival, nest success, and chick survival. We collect vegetation data at nests and unused sites in potential sage-grouse nesting habitat to measure the influence of grazing treatments on sage-grouse nest site selection and nest success. We also collect vegetation data in rested and unrested pastures to obtain distinct measures regarding the effects of grazing on sage-grouse habitat.

The preliminary results from the first 4 years of this study indicate that SGI systems are having a positive impact on live and residual grass cover, which has translated into improved nest success on land enrolled in SGI versus non-SGI areas (see **HIGHLIGHTS OF PRELIMINARY RESULTS FROM PREVIOUS REPORTS** below).

NEW PROGRESS: NOVEMBER 2014 – APRIL 2015

We monitored marked hens once per month via aerial telemetry from Nov 2014 – Mar 2015 (defined as the winter season; Blomberg et al. 2013). Winter survival of hens in 2014 (Nov 2014 – Mar 2015) was high at 97%: 2 hens died presumably from predation, 1 SGI hen and 1 non-SGI hen. High winter survival is typical for this species (Connelly et al. 2011). Annual survival of hens in 2014 (1-Apr-2014 to 31-Mar-2015) was 67% (2011=57%, 2012=65%, 2013=76%). Sage-grouse typically have high annual survival as well (Connelly et al. 2011). The apparent annual survival of hens during 2014 is within the range observed on this study and others (Aldridge and Brigham 2001, Connelly et al. 2011, Holloran 2005, Sika 2006), but was lower than expected due to relatively high mortality during the fall. This winter we made progress in entering 2014 field data and proofreading all field data, and we are continuing these activities this spring. Working with data and analyses is an ongoing process. We have had ongoing communication with landowners, and hosted the annual oversight committee meeting for project partners in January 2015.

We began our 5th year of this 10 year study in April 2015. We captured and marked 53 new hens with radio transmitters to replace marked hens that died during the 4th year. We ended captures with 103 marked hens. Subsequently we have lost 2 non-SGI hens and 1 SGI hen due to predation, and 1 hen has been censored out of our marked population due to a dropped transmitter. We are currently finding and monitoring nests. The first nest was found on April 17th, which is 2 days earlier than first nest dates in previous years (Fig. 1). By April 24th this year we had at least 25 hens nesting, which is more nests found by that date than we have found in

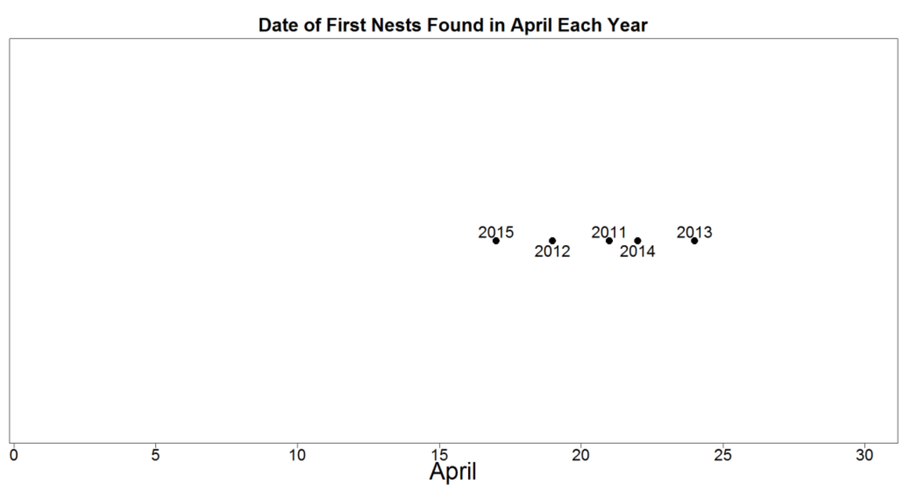

Figure 1. The date that first nests of greater sage-grouse were found each year in Golden Valley and Musselshell counties, Montana.

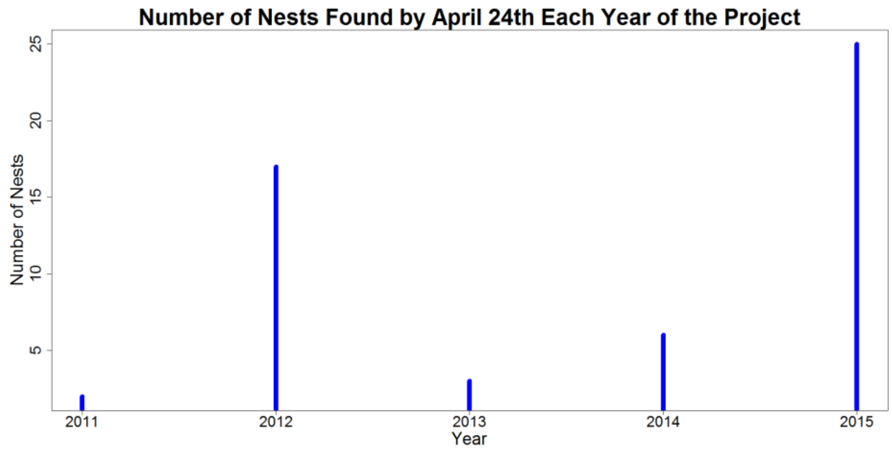

Figure 2. The number of nests of greater sage-grouse found by April 24th each year in Golden Valley and Musselshell counties, Montana.

previous years (Fig. 2). We caution not to inference from these data because they have not been formally analyzed or standardized by nest search effort.

We have continued our partnership that we began in 2014 with USFWS to expand our habitat sampling to the Lake Mason satellite units of the Charles M. Russell (CMR) National Wildlife Refuge in Musselshell County. USFWS is planning to implement SGI systems on the refuge units in the fall of 2015. This expanded sampling is funded through at least June 2017. Please see the biannual report submitted for the period covering May – Oct 2014 for more background on this partnership.

We also continue our partnerships with 2 other projects on our study area: (1) "Sagebrush and Grassland Bird Responses to a Rest-rotation Grazing Management Strategy" by Victoria Dreitz from The University of Montana and (2) "Demonstrating and Quantifying the Influences of Incentive Based Rest Rotation Grazing on Food Insects of Sage-grouse, Rangeland Pollinators, and Vectors of West Nile Virus" by Hayes Goosey from Montana State University. We still anticipate a collaborative report among the 3 projects in the next 3 to 5 years, in which we will assess grazing impacts on sage-grouse, songbirds, and insects of the sagebrush ecosystem.

Activities for the Next Six Months

We will continue monitoring hen survival and habitat use from the ground twice per week from Apr – Aug 2015, and using aerial telemetry once per month through the remaining fall and upcoming winter. We will continue monitoring nests (Apr – Jun 2015), capture and mark chicks with radio transmitters (May – Jul 2015), and measure key vegetation characteristics in sage-grouse habitat and in areas with varying grazing treatments. We will continue work on data entry and proofreading, as well as analyses. We also will continue to communicate the progress of our study to landowners via landowner updates, and to our oversight committee and partners via regular communication and formal written updates. We are planning upcoming outreach activities including a landowner appreciation dinner in July 2015; an invited presentation of our project at the "FWP at Work" event at Montana WILD in October 2015; an invited presentation of our project to the BLM in Billings on May 13, 2015; an invited presentation of our project to the USFWS, local landowners, and the Charles M. Russell National Wildlife Refuge working group in Jordan in June 2015; and a presentation of our project at the 5th Annual Matador Ranch Science and Land Management Symposium in June 2015.

HIGHLIGHTS OF PRELIMINARY RESULTS FROM PREVIOUS REPORTS

** Please see the progress report sent in December 2013 for the full preliminary evaluation.*

The first 3 years of our study from 2010 – 2013 yielded positive preliminary results showing that SGI is on the right track. Our project evaluated the effectiveness of SGI grazing systems as a habitat management tool for stabilizing or improving sage grouse habitat and populations. Part of the goal of SGI is to "grow more grass" to produce more hiding cover for nesting hens. Our preliminary results (Berkeley et al. 2013) indicated a trend that pastures enrolled in SGI produce taller grass. Fig. 1 shows a summary of residual grass heights in Non-SGI (these pastures were

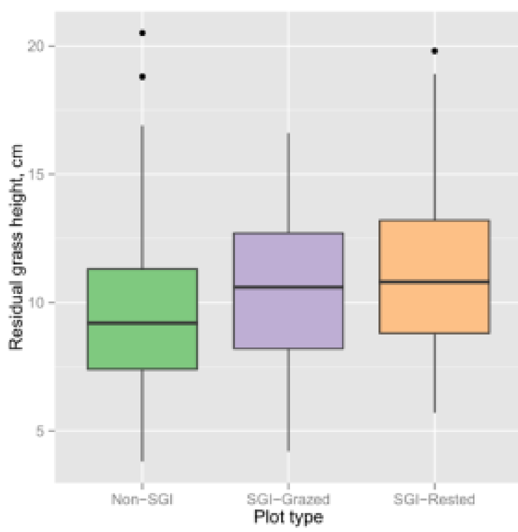

Figure 1. Residual grass height at vegetation response plots on non-SGI pastures (n = 117), SGI pastures grazed in the past year (n = 47), and SGI pastures that had been rested from grazing since the previous nesting season (n = 114). All plots were measured in July 2013.

grazed by private landowners, but not using SGI systems), grazed SGI, and rested SGI pastures. The residual grass height appeared greatest in rested / deferred (≥15 months) SGI pastures, but appeared to be greater in both grazed and rested SGI pastures than in non-SGI pastures. Nesting sage grouse hens seemed to select these areas with more residual grass (Fig.

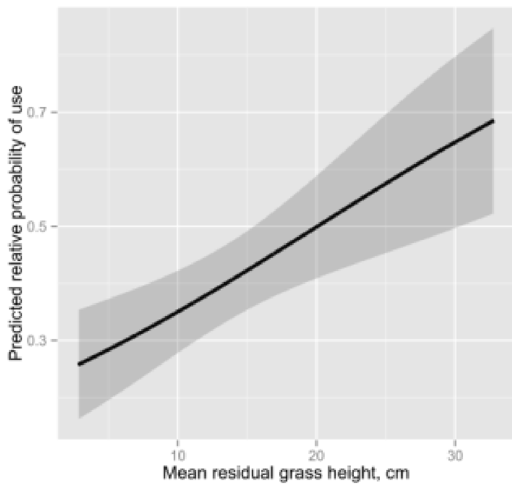

Figure 2. Predicted relative probability of use as a function of residual grass height (excluding inflorescence) within 6 m of the nest shrub from top RSF model. Predictions are made with all other covariate values held at their mean value. Shaded gray area is the 95% confidence region calculated using the delta method as implemented using the predictSE.mer() function in the AICcmodavg package in program R.

2), and preliminary analyses show that their nests were more successful in areas with more residual grass (Fig. 3). In addition, our collaborator Hayes Goosey from Montana State University (project "Demonstrating and Quantifying the Influences of Incentive Based Rest Rotation Grazing on Food Insects of Sage grouse, Rangeland Pollinators, and Vectors of West Nile Virus") has preliminary results showing that the insects that sage grouse hens and chicks

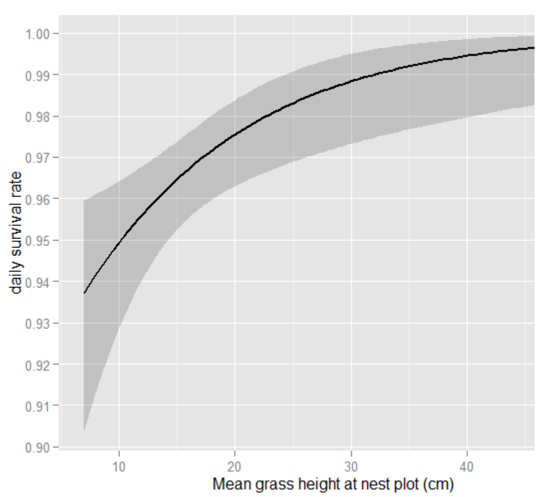

*Figure 3. Daily survival rate of greater sage grouse nests as a function of average grass height within 6 m of the nest shrub in Golden Valley and Musselshell counties, MT from the top-ranked model of daily survival rate (Year + Year*SeasonDay + Pgrass_ht); predicted DSRs are based on a nest midway through the 2013 nesting season.*

rely on for food during the summer are more abundant where grass is taller (Fig. 4). Preliminary analyses "suggest that rested/deferred pastures harbor an increased abundance of food arthropods (Fig. 5; Goosey 2014). Thus, our preliminary evaluation suggests that SGI is benefitting sage grouse.

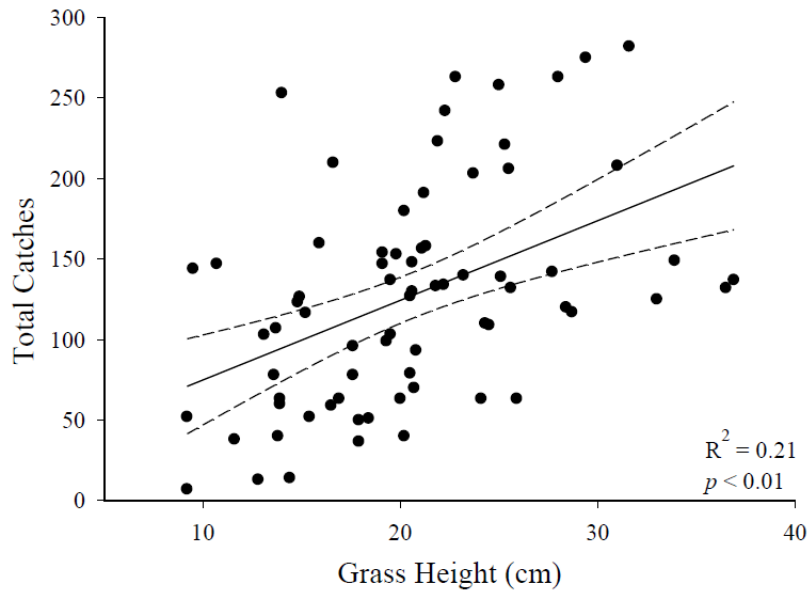

Figure 4. Linear relationships (solid line), with 95% confidence intervals (dashed lines), between the total pitfall trap catches of food arthropods for sage grouse (collected across all dates) and live grass height (from Goosey 2014).

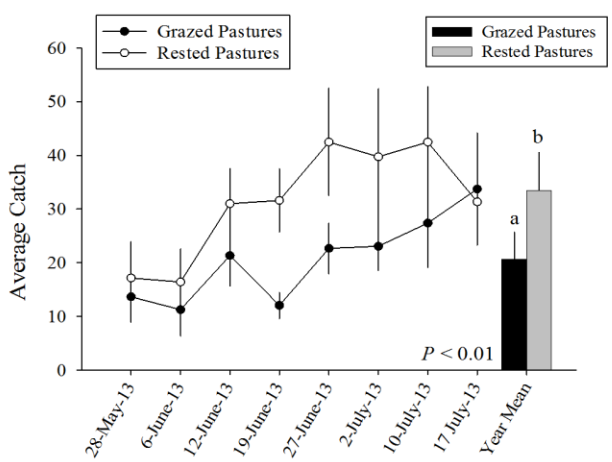

Figure 5. Averaged catches across all arthropod taxa (beetles, butterfly and moth larvae, grasshoppers and crickets, ants, and spiders) in pastures which were either rested/deferred or grazed during the early brooding period of late May to early July. Lines represent the average weekly catches, bars represent the averaged catch for the sampling year, and error bars represent the standard error of the mean (from Goosey 2014).

We examined chick survival up to 80 days post-hatch (until chicks died or their radio-transmitters failed) using nest success models in program MARK (White and Burnham 1999). We used the nest success rather than known fate models to assess chick survival because the exact mortality dates of some chicks were not known and chicks were marked on multiple dates throughout the season. These models were used to estimate the variation in survival due to chick age and year (Table 1). We used an information theoretic approach to assess which models best fit the data. Individuals whose signal was lost or their fate could not be determined (e.g., dropped tag versus death) were removed from the analysis. We found that variation in chick survival was best explained by a model including age-specific differences, with a model including age and year as the only competing model (Table 1, Fig. 6). Examination of the effects of other variables on chick survival (e.g., weather, vegetation factors) is in progress.

Model Number	Model Description	AIC_c [a]	Δ AIC_c [b]	K [c]	w_i [d]
1	Age	580.57	0	2	0.73
2	Year + Age	582.55	1.98	3	0.27
3	Constant [e]	626.05	45.48	1	0
4	Year	628.05	47.48	2	0

[a] Akaiki Information Criterion for small sample sizes
[b] Difference in AIC_c values between model *i* and the top-ranked model (model with the lowest AIC value)
[c] Number of parameters
[d] AIC weights
[e] Assuming a constant survival rate for the entire monitoring period

Table 1. Akaiki's Information Criterion for small sample sizes was used to rank survival models for radio-marked sage-grouse chicks monitored north of Roundup and Lavina, MT in 2012 (n = 80) and 2013 (n = 50).

Chick mortality was highest during the first month after hatching (Fig. 6). This result is comparable to survival observed in other studies of sage-grouse and other prairie grouse chicks. The primary causes of mortality during the first few weeks after hatching are typically exposure to cold or wet weather, predation, lack of food, and poor condition of the chick or female (Kirol 2012). Based on the observed range of daily survival rates during the study (93-99%), the survival rate from hatching to 80 days old was 0.13 (SE = 0.03, 95% CI = 0.079 – 0.21) each year.

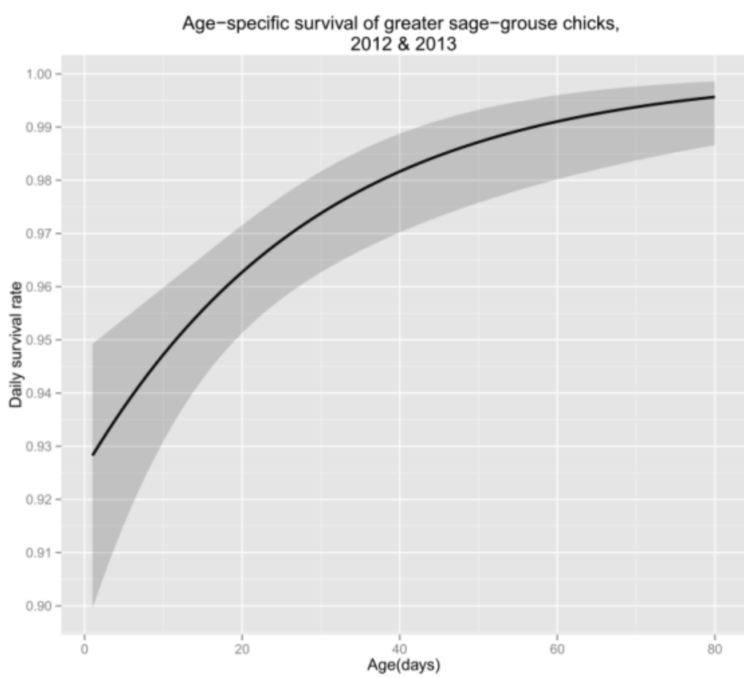

Figure 6. Survival curve showing the effect of chick age on daily survival rate for greater sage-grouse chicks in Musselshell and Golden Valley counties, Montana

LITERATURE CITED

Aldridge, C. L., and R. M. Brigham. 2001. Nesting and reproductive activities of greater sage-grouse in a declining northern fringe population. Condor 103.

Berkeley, L. I., J. T. Smith, and M. S. Szczypinski. 2013. Evaluating sage grouse and habitat responses to sage grouse friendly livestock grazing strategies. Unpublished Final Progress Report to the Natural Resources Conservation Service upon completion of Conservation Innovation Grants funding. Montana Fish, Wildlife, & Parks, Helena, Montana, USA, 62 pp.

Blomberg, E. J., J. S. Sedinger, D. V. Nonne, and M. T. Atamian. 2013. Seasonal reproductive costs contribute to reduced survival of female greater sage-grouse. Journal of Avian Biology 44:149-158.

Connelly, J. W., C. A. Hagen, and M. A. Schroeder. 2011. Characteristics and dynamics of greater sage-grouse populations. Pages 53-67 *in* S. T. Knick, andJ. W. Connelly, editors. Greater sage-grouse: ecology and conservation of a landscape species and its habitat. Studies in Avian Biology (vol. 38). University of California Press, Berkeley, California, USA.

Goosey, H. 2014. Food arthropod abundance associated with rest-rotation livestock grazing. Unpublished report, Montana State University, Bozeman, Montana, USA.

Holloran, M. J. 2005. Greater sage-grouse (*Centrocercus urophasianus*) population response to natural gas field development in western Wyoming., University of Wyoming, Laramie, Wyoming.

Kirol, C. P. 2012. Quantifying habitat importance for greater sage-grouse (*Centrocercus urophasianus*) population persistence in an energy development landscape., University of Wyoming, Laramie, Wyoming.

Sika, J. L. 2006. Breeding ecology, survival rates, and causes of mortality of hunted and nonhunted greater sage-grouse in central Montana., Montana State University, Bozeman, Montana, USA.

Taylor, R. L., B. L. Walker, D. E. Naugle, and L. S. Mills. 2012. Managing multiple vital rates to maximize greater sage grouse population growth. Journal of Wildlife Management 76:336-347.

White, G. C., and K. P. Burnham. 1999. Program MARK: survival estimation from populations of marked animals. Bird Study Supplement 46:120-139.